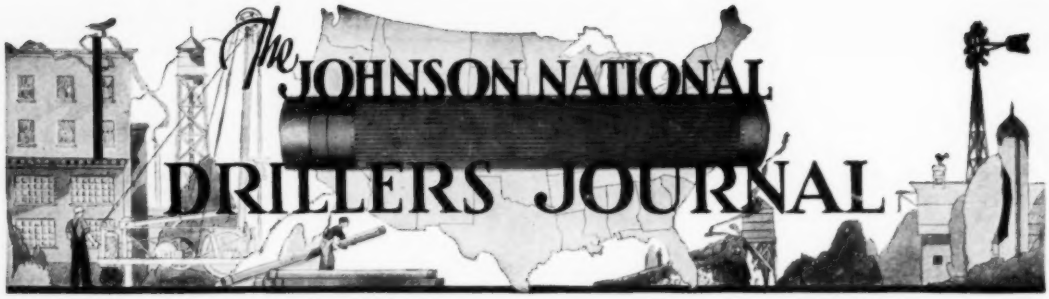

Vol. 22, No. 3 THE JOHNSON NATIONAL DRILLERS' JOURNAL May-June, 1950

GROUND WATER RESOURCES AND THEIR CONSERVATION

This Journal is published for the benefit of well drillers, public officials and others interested in the development and use of ground water.

It is not intended to be critical, but helpful and constructive at all times. We hope that each group of readers finds something that applies to their particular interest in ground water.

THE ROCK SYSTEMS

Our ground water resources are becoming of such vital importance in our daily life and economy that more thought and attention are now being given to such questions as their origin, source, and location. To fully understand these problems, it is necessary to have some knowledge of ground water formations. In other words, we must know where our water-bearing formations are, how they come to be there, how they obtain their water, how much water they will yield to wells, and other similar information.

This involves a study of our rock systems and groups. Long years of study by geologists have resulted in a time scale by means of which the age of rock formations can be determined roughly. However, the age of rocks is not always a key to their water-bearing capacities. If we have a log of the rocks in a given location showing the presence and location of water-bearing formations, we do not study them from the standpoint of age but rather from the standpoint of depths, position and their ability to hold and transmit water. As a general thing, the younger formations lying nearer the surface, are more porous, and easier to reach by drilling. In any rock series, however, the best water-bearing formation is likely to be the basal conglomerate or sandstone.

The rock formations of the United States have been grouped by the late Dr. O. E. Meinzer of the U. S. Geological Survey, (Water Supply Paper 489), into twelve rock systems. These systems have been further divided into several rock series. The various systems and series being separated from one another by unconformities. The time required to form a rock system is called a geologic period and the time required to form a series is called a geologic epoch. Thus we have the following relations between time and rocks by means of which we can judge their age and their characteristics:

TIME SCALE	ROCK SCALE
Era	Group
Period	System
Epoch	Series
Age	Stage

Thus we speak of the Tertiary period of time, but the rocks of that time are referred to as rocks of the Tertiary system. This description may be further broken down into epochs of time such as Pliocene, in which case the rocks would be referred to as rocks of the Pliocene series of the Tertiary system.

The twelve rock systems in the United States starting with the oldest are:

1. Archean System.
2. Algonkian System.
3. Cambrian System.
4. Ordovician System.
5. Silurian System.
6. Devonian System.
7. Carboniferous System.
8. Triassic System.
9. Jurassic System.
10. Cretaceous System.
11. Tertiary System.
12. Quaternary System.

The deposits of each of these systems, with their fossils, form the picture of physical changes and life occurring in the corresponding period of geologic time. From the standpoint of ground water, great changes took place at the end of the Algonkian period, the Carboniferous period and the Cretaceous period. These changes are indicated by three unconformities which have an important bearing on ground water conditions.

The Archean and Algonkian systems which lie below the lowest of the three unconformities are commonly called pre-Cambrian rocks of pre-Cambrian time.

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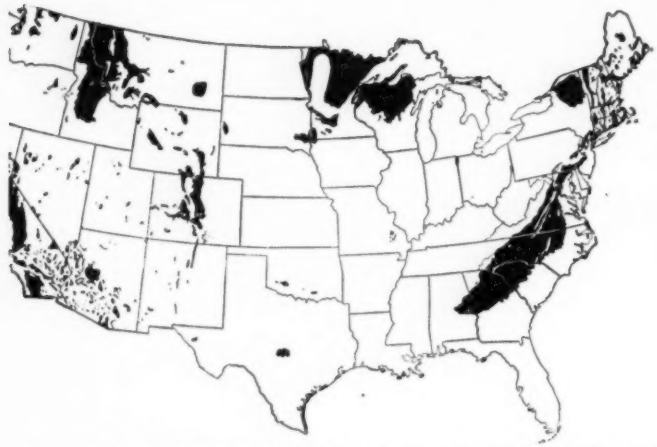

The areas where Cambrian rocks are at or near the surface. Small supplies may be obtained from dug wells in places where the rock has distintegrated or from deeper drilled weels. (After W.S.P. 489).

Ground Water Resources and Their Conservation

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The remaining systems are separated into three major groups corresponding to eras of geologic time; (1), the Paleozoic, composed of the Cambrian, Ordovician, Silurian, Devonian, and Carboniferous systems; (2), the Mesozoic, composed of the Triassic, Jurassic, and Cretaceous systems, and the Cenozoic, composed of the Tertiary and Quaternary systems. The most important systems from the standpoint of ground water are those of the Carboniferous, Cretaceous, Tertiary, and Quaternary systems, as they are nearest to the surface. These systems are subdivided into series, the names of which are quite familiar to geologists and drillers of deep rock wells.

Not too much is known of the rock formations prior to pre-Cambrian time. It is known, however, that pre-Cambrian rocks are exposed at the surface in many places, as indicated by the map. As a rule, they are the heavy, dense rocks forming a rock base as far as drilling and ground water are concerned. These rocks form the hard, impervious base upon which all younger deposits rest with their various water-bearing formations. Where these rocks are buried 100 feet or more under sedimentary beds, they have little or no value as water producers. Where they are at the surface, they may furnish small but reliable supplies of water. In the northern part of the United States these rocks, even when at or near the surface, are generally covered with glacial drift which is much more liable to produce water than the basal rock. In places where the glacial drift is absent, it is oftentimes possible to obtain supplies from wells drilled into the basic rock or from the weathered portion just beneath the upper surface. The largest areas of pre-Cambrian rocks are in the East, the Lake Superior region, and the Rocky Mountains. Other areas are in the Ozarks, the Wichitas, the Black Hills, and many widely scattered places in Arizona and southeastern California. In the East, the principal water-bearing pre-Cambrian rocks are in the Piedmont Plateau, the Appalachian Mountains, the Adirondack Mountains, and in parts of New England. On the Piedmont Plateau these rocks are a very important source of water supplying practically all of the domestic supplies and many small industrial and public supplies, the largest being obtained from streams whose flow is obtained from springs in these rocks.

In the Lake Superior region where these rocks are found near the surface in the northern peninsula of Michigan, the northern half of Wisconsin, the western and northern parts of Minnesota, and in small areas in North Dakota, South Dakota, and Iowa; they are overlain by thin Cretaceous deposits and therefore are not a main source of water supply. In the Rocky Mountains and farther West, the pre-Cambrian rocks are principally granite which in places has been weathered and worn down to form pockets filled with porous disintegrated rock. In such places, small supplies have been obtained from wells in arid regions. In western Montana and northern Idaho, large areas are underlain by Algonkian rocks but they are unsatisfactory as far as being a source of water supply.

The rocks of the Paleozoic group are one of the most important sources of ground water supply in the United States, as they are made up of heavy beds of sandstone, shale, and limestone extending over large areas in the eastern and central part of the country. These areas include most of New York, Pennsylvania, West Virginia, Kentucky, Tennessee, northern Alabama, nearly all of Ohio, Indiana, Illinois, Iowa, Missouri, and Oklahoma, the southern peninsula of Michigan, large portions of Wisconsin, Minnesota, southeastern Nebraska, eastern Kansas, north-central Texas, and northwestern Arkansas.

With few exceptions the Paleozoic formations in the central and eastern part of the United States lie nearly horizontal and are easily recognized by drillers at definite depths below the surface. Southward these formations lie beneath the Coastal Plain. Westward under the Great Plains these formations are buried under younger deposits, though in the New Mexico-Texas region Paleozoic formations appear and in the Pecos Valley are water bearing.

The most important problem in connection with Paleozoic wells is the quality of the water obtained from them. In many places where these formations lie several hundred feet below the surface, the water is salty and cannot be used. This is due to the slow movement of ground water at some distance below the levels of the principal streams. In other words, it seems

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that the quality of water in Paleozoic rocks is dependent on its position with respect to the surface drainage rather than the formation itself.

When these formations are found within 200 or 300 feet of the surface, the water in them is usually of good quality, though it may be somewhat hard. In Kansas, Oklahoma, and Texas the water from the shallow Paleozoic rocks commonly contains too many minerals to be used.

It will be noticed that the Cambrian system lies lowest in the Paleozoic group. These rocks are at or near the surface in parts of New England and eastern New York, and in parts of the Appalachian Mountains in Pennsylvania, Maryland, West Virginia, Virginia, North Carolina, South Carolina, Tennessee, Alabama, and Georgia. Further west they are deeply buried under younger Paleozoic rocks, but they are found again at or near the surface in a large area in Wisconsin, Minnesota, Iowa, and the northern peninsula of Michigan, also in Missouri and Arkansas. Isolated outcrops are found in several places farther west.

In the East the Cambrian rocks have been much changed from their original state. They consist largely of quartzite, slate, schist, and crystalline limestone. In the southeastern part of the Appalachian region, the system is exposed over wide areas and in many places is thousands of feet thick, including thick limestone formations in its upper part. In the Paleozoic area of the eastern and central United States, Cambrian rocks are mostly sandstone generally a few hundred feet in thickness. The Cambrian sandstones of the Mississippi Valley are among the best water-bearing formations in the United States. In Wisconsin, Minnesota, Iowa, Illinois, Missouri, and Arkansas they furnish generally yields of water for many municipalities and industries. These wells, some 1,000 feet deep, belong to one of the most productive artesian basins in the country and are a source of additional water supplies in the future as the water in the higher formations becomes more fully developed.

East of this region in Indiana, Ohio, and the southern peninsula of Michigan and in large parts of New York, Pennsylvania, West Virginia, Kentucky, and Tennessee, the Cambrian sandstones are deeply buried and contain only salt water. West of the Mississippi Valley region the Cambrian formations pass to greater depths and their water becomes highly mineralized. For this reason they are not a practicable source of water supply in southwestern Minnesota, western Iowa, northwestern Missouri and regions to the west. Consequently these formations are not of great importance as a future supply of ground water in the western half of the United States.

The rocks of the Ordovician system lie above the Cambrian and follow the same general pattern of distribution. The most important areas as far as water supply is concerned are in southeastern Minnesota, northeastern Iowa, northern Illinois, southern and eastern Wisconsin, and in the eastern part of the northern peninsula of Michigan. The second most important is a large crescent shaped belt in southern and eastern Missouri encircling the Ozark Mountains. There are other areas such as the anticline extending from northwestern Alabama to eastern Indiana which contain water but at considerable depth and highly mineralized. There are many other widely separated areas where water supplies are obtained from this formation but they do not constitute a major source of water supply.

In the Mississippi Valley one of the most valuable sources of ground water is the St. Peter sandstone of this system. It underlies nearly all of Iowa and Missouri, parts of the states adjoining, nearly all of Illinois and adjacent parts of Wisconsin, nearly all of Indiana, and large parts of Michigan, Ohio, and Kentucky. It varies in thickness from place to place but is usually not more than 200 feet thick, and consists of a slightly cemented porous sandstone composed of rounded quartz grains.

Below the St. Peter sandstone the Ordovician formations are mostly limestone or dolomite. In Iowa and Minnesota the Shakopee dolomite is above and the Oneota dolomite below. The Shakopee contains beds of sandstone while the Oneota is usually heavy limestone. Considerable water is obtained from the Shakopee in places.

Above the St. Peter sandstone is a group of beds mostly limestone and dolomite. The upper and thickest bed is called Galena limestone. Throughout Iowa, Minnesota, Wisconsin and Illinois it is considered a source of fairly large supplies of hard water. The upper part of the Ordovician system throughout eastern and central United States consists mostly of shale and therefore yields very small supplies of water, if any.

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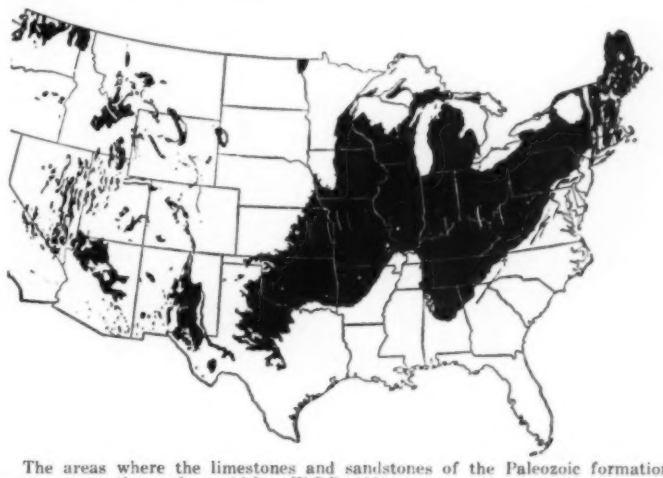

The areas where the limestones and sandstones of the Paleozoic formations are at or near the surface. (After W.S.P. 489).

Ground Water Resources and Their Conservation

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The Silurian system lying above the Ordovician is less widely distributed than the Cambrian and Ordovician systems. It is thin or absent in the West, but is present under most of the Paleozoic area in the eastern and central United States. These rocks are mostly limestone and dolomite and are important as sources of water supply in Iowa, Illinois, Wisconsin, Indiana, and Ohio on account of their caverns and solution channels. The principal formation is known as the Niagara limestone, though in Ohio a thick bed of limestone found above the Niagara and called the Monroe formation is the best water producer in the state with the exception of the large supplies found in the glacial drift. In Michigan and northeastern Ohio the Salina formation containing salt water lies between the Monroe and Niagara formations.

The next higher system in the Paleozoic group is the Devonian system lying above the Silurian. Throughout New York, Pennsylvania, Maryland, Virginia, and West Virginia, the formation is several thousand feet thick though in southern New York and northern Pennsylvania it outcrops or lies immediately below the glacial drift in many places. It consists of limestone, sandstone, and shale which in this region yield small supplies to shallow drilled wells. It extends to the west and southwest but thins out rapidly and in many places it is absent from the Paleozoic section. As a whole it is not a potential source of additional water supplies.

The Carboniferous system lying above the Devonian in the geologic section is the most extensive system in the Paleozoic group. In places it is thousands of feet thick and extends all over the country. It is found at the surface or immediately below the glacial drift. The system is subdivided into three series, the Mississippian, the Pennsylvanian, and the Permian. The Mississippian consists largely of heavy beds of sandstone and shale, while the Pennsylvanian is a succession of thin layers of discontinuous stratas of shale, sandy shale, sandstone, limestone, and coal. It is 1,000 feet or more in thickness in the Mississippi Valley. The Permian occurs in Pennsylvania and adjacent states but is more extensive in the Southwest where it is recognized by its reddish color with limestone, gypsum, and salt. Well drillers refer to this formation as the "Red Beds." On the whole, these rocks, especially the Pennsylvanian and Permian are not good water bearers.

At the end of the Paleozoic era great changes took place in the rock surfaces of North America. There are three rock systems in the Mesozoic era which followed, the Triassic, the Jurassic, and the Cretaceous. Inasmuch as the first two systems are not extensively exposed, they are relatively of little importance as a source of ground water. The third system, the Cretaceous, is widespread and being near the surface is one of

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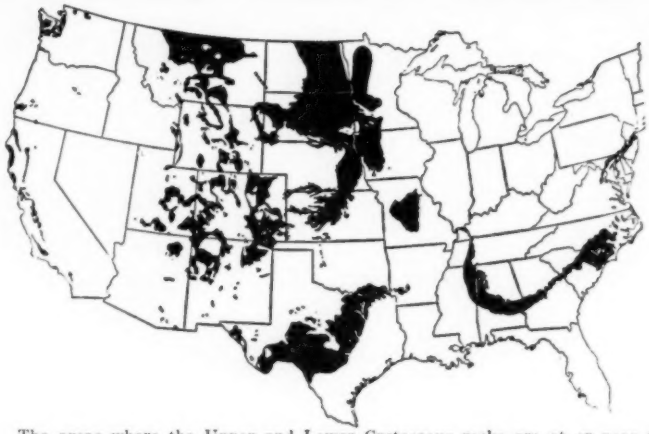
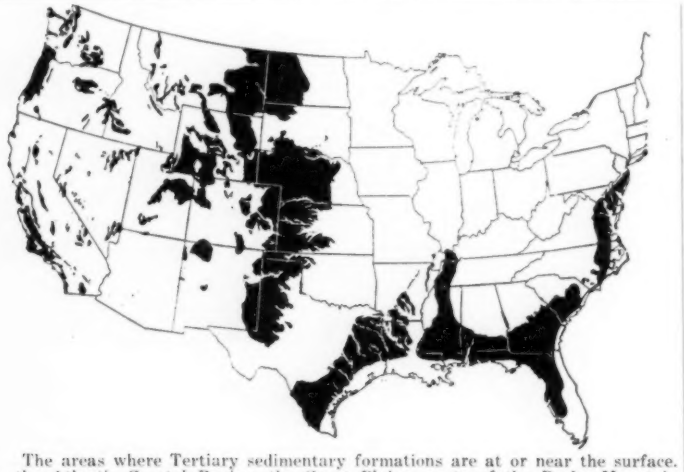


The areas where the Upper and Lower Cretaceous rocks are at or near the surface. In the eastern part of the United States and in Texas the water-bearing formations of the Lower Cretaceous are important. In the western interior these formations hold little water. In the Pacific Coast region they are not important. The formations of the Upper Cretaceous in the Atlantic Coastal Plain contain several important water bearers. In the western interior the basal formation is the Dakota sandstone, a valuable artesian reservoir. (After W.S.P. 489).



The areas where Tertiary sedimentary formations are at or near the surface. In the Atlantic Coastal Region, the Great Plains, parts of the Rocky Mountain region, and the Colorado Plateaus there are water-bearing formations that yield large supplies of water. (After W.S.P. 489).

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the most important of all the rock systems as a source of water. This system is divided into two series, called the Upper and the Lower Cretaceous. The Cretaceous formations are found in three well known areas, the Atlantic Coastal Plain including that part adjacent to the Gulf of Mexico, the Great Plains of the middle west, and the Pacific coast region. The Upper Cretaceous are naturally more widely spread than the Lower Cretaceous formations and therefore are a more important source of ground water. The formation as a whole can be said to consist principally of sands, gravels, clay, marl, and similar unconsolidated formations.

In the Atlantic Coastal Plain these formations rest on the Lower Cretaceous, except locally where they overlap the Lower Cretaceous and rest on older rocks. They crop out or lie immediately below the surface deposits from Massachusetts to the Mexican Border, with exceptions found in Virginia, North Carolina and the lower Mississippi embayment. They dip gently seaward like the Lower Cretaceous and pass beneath the overlying younger deposits that gradually increase in thickness toward the sea.

The Upper Cretaceous varies considerably beneath the Atlantic Coastal Plain but practically everywhere it contains some good water-bearing beds, and its water is generally of satisfactory quality, except at considerable depths, where it may be salty.

In the southern part of North Carolina and northern part of South Carolina, the Upper Cretaceous outcrops extensively, while in Georgia and Alabama the formation thickens and includes much marl, chalk and soft limestone. In this region the formation yields much water from its sand beds. In eastern Texas the Upper Cretaceous attains a maximum thickness of 3,000 feet, in the central and northern part of the Great Plains, extending eastward to central Minnesota and Iowa and southward into New Mexico. It underlies a large part of the Rocky Mountain region and outcrops in numerous places. It also underlies most of the high plateaus of western Colorado, eastern Utah, northwestern New Mexico and northeastern Arizona. Throughout most of these areas, the Dakota sandstone underlies this formation. The Dakota sand, as drillers know, is on of the best and most valuable water-bearing formations in the United States, and is found in most of North Dakota, South Dakota, and Nebraska as well as large parts of Montana, Wyoming, Colorado, New Mexico, Utah, and Arizona. It is also found in western parts of Minnesota, Iowa, and Kansas.

Above the Dakota sandstone are the Graneros shale, Greenhorn limestone, and Carlisle shale. These formations are not good water yielders. In the western states these formations are locally known by various names, but as a whole yield very limited supplies, if any. However, in western Colorado and northwestern New Mexico, the Dakota sandstone contains considerable water.

In the Pacific Coast region the Upper Cretaceous is composed of sedimentary beds having a thickness of 4,000 feet in places. It is exposed in many places in the Coast Ranges and is not important as a source of water.

The Cenozoic era followed the Mesozoic and includes the present time. The rocks of this system being the youngest are naturally at the surface in many places. The system is divided into two series, the youngest, the Tertiary and the older, the Quaternary. These two series are both important as sources of water. The Quaternary which includes the glacial drift and most of the water-bearing alluvial deposits of the West is without question the greatest single source of ground water in this country. The Tertiary is probably the next most important source of ground water. Next to it and below are the formations of the Cretaceous which are next in rank as water-producing rocks.

The rocks of the Tertiary are not as thick as some of the older formations but they are sedimentary and are found over large areas of the country, such as the Atlantic Coastal Plain, the sediments of the central, northern and southern portions of the Great Plains, parts of the Rocky Mountain region and the Colorado Plateaus, the lava beds of the Columbia Plateaus, all of which yield more or less water. The Great Plains area is largely underlain by gravelly, sandy, and clayey materials which were spread smoothly over them by streams from the Rocky Mountains. These deposits though not more than a few hundred feet in thickness are sufficiently porous to furnish water most everywhere in satisfactory quantity. Taken all together this formation is the largest single underground reservoir in this country supplying large numbers of wells with water of high quality

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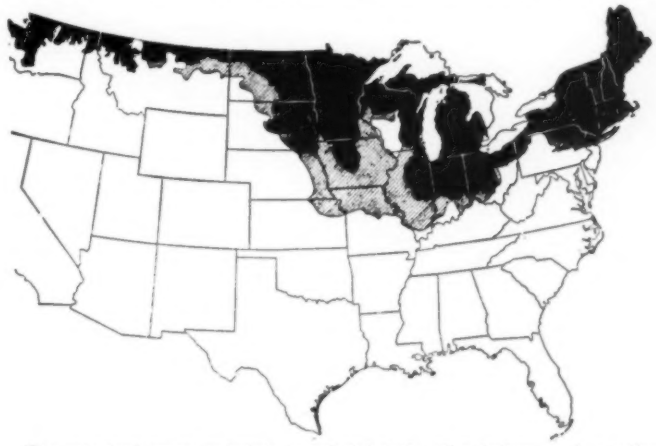


The principal areas underlain by glacial drift. The darker portion indicates the Wisconsin or latest drift sheet; the lighter portion indicates older drift. The drift is the most important source of ground water in the northern part of the U. S. (After W.S.P. 489).

(Continued from Page 5)

for all purposes at reasonable pumping lifts.

The Quaternary system which is the youngest and highest is even better as a source of water supply than the formations of the Tertiary. The glacial till covers large areas along the northern border of the country and extends southward into Iowa, parts of Nebraska, Missouri, nearly all of Illinois, Indiana, and Ohio, all of Michigan, and eastward into New York and the New England states. Outwash deposits of glacial material are the chief water suppliers in New England. They are extensive in the Mississippi Valley and the drainage basin of the Great Lakes. These deposits are usually found between the drift sheets of older soils and various wind and water deposits.

In the western part of the United States broad valleys lying between the mountain ranges contain large deposits of rock waste known as "valley fill." These deposits are the great water bearers of an arid part of the United States. They are irregular in distribution but yield water in most places. In addition to the glacial deposits of the Quaternary system, there are deposits of alluvial sand and gravel such as are found in the valleys of the Platte and Arkansas Rivers. The surface deposits of the Atlantic Coastal Plain are largely of alluvial origin, though there are some estuary and shore deposits.

Well drillers are so familiar with our surface formations that they will not be discussed further. Needless to say there is a vast amount of information available to drillers and engineers in our state geologists' offices and the U. S. Geological Survey in Washington, D. C. Increasing use will be made of this information as our need of ground water supplies increases, and the necessity of developing new sources of ground water supplies becomes apparent.

Farmer—"This is a tobacco plant."

City Miss—"And how long will it be before the cigarettes are ripe?"

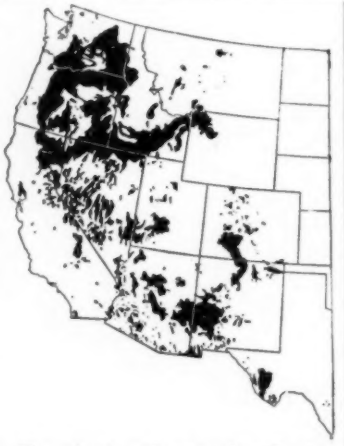
—Public Service News.

REVERSE ROTARY DRILLING

Water wells have been drilled by the rotary method for fifty years. Most drillers are familiar with the method even though they do not operate rotary equipment. Probably this is due to the fact that the use of rotary equipment has not been popular for water wells. In fact this method of drilling water wells was frowned upon until recent years.

The reasons for this are quite obvious as rotary drilling has some objectionable features as far as water wells are concerned, the principal ones being that it is difficult, if not impossible, to obtain accurate samples and a log of the hole being drilled. Many a rotary hole has been abandoned on account of the water-bearing formations being passed up or the loose granular formations being carried down with the tools into tight non-water bearing beds; or the drill hole being "mudded up" so tight that the well would not yield water.

In any rotary method of drilling the drill hole is kept full of a thick, heavy, muddy fluid which is intended to penetrate into the pore spaces or voids of the formation being drilled and to form a self-supporting mud cake or seal on the face of the drill hole. This is done in order that the entire string of casing including screens can be installed at one operation. A large portion of the success or failure of rotary drilled wells depends upon the makeup of the mud fluid and the care with which it is used. Most important of all is the removal of this mud from the formation after the casing and screens are in place. The use of too much or the wrong kind of drilling mud will oftentimes build up a mud cake on the walls of the drill hole that cannot be entirely removed regardless of the methods used to do so. This means a bad well for the customer and a black eye for the driller.



The volcanic rock area where Tertiary or Quaternary formations are at or near the surface. The lava beds in Idaho, Washington, and Oregon, consisting chiefly of basalt, yield large supplies of water to many wells and springs. (After W.S.P. 489).

Since World War II the use of rotary equipment in drilling water wells has increased all over the country, possibly due to the fact that more young drillers are familiar with this type of equipment than any other and also the fact that this is the fastest method of drilling known in all formations, except hard, solid rock. As a matter of fact, water wells were being drilled by rotary methods long before World War II, not only by the direct rotary method similar to that which had been used in the oil fields for years, but by a method known as the reverse rotary method. Just where and when the reverse rotary method was first used is not known, but it was being used in Nebraska thirty years ago.

Many drillers and engineers do not know just what the differences are between these two methods of rotary drilling. It is our purpose here to point out these differences in simple language as reverse rotary drilling machines are now being manufactured on a commercial basis, and are becoming popular in certain areas of the country where they can be used to advantage.

Direct rotary drilling is done by rotating a string of drill pipe which has a cutting tool or drill bit on the lower end. This drill bit carries most of the weight of the drill pipe and as it is rotated, it cuts and loosens the material being drilled. The drill pipe is rotated by means of a special top section known as a "kelly," which also allows the drill pipe to move downward as it is being rotated. The drill pipe being hollow allows the drilling "mud" to be pumped down

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This is a picture of four generations of well drillers in Ohio. Reading from left to right, are: S. B. Bushong, 89, who started drilling when he was 16 years old; his son, L. E. Bushong, 56, who started drilling when 15 years old; the grand son-in-law, R. C. Cowan, who entered the business in 1945; and the great grandson, Jack Cowan, who will be a well driller in a few years. Mr. L. E. Bushong was President of the Ohio Well Drillers Asscoiation in 1949.

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through it to the bit by means of pressure pumps. The drilling fluid picks up the loosened material and carries it to the surface between the drill pipe and the drill hole where it overflows into a mud pit. The coarser material drops out in this pit and the overflow of muddy water goes into another pit where it is picked up by the circulating pressure pumps and used again. As we have said, the "mud" used must be of the right kind and amount to plaster up the walls of the drill hole and still be easily removed. If local clay will not make a satisfactory mud, then something like aquajel must be used in the drilling water. Needless to say, the circulating pumps must be of the right type and capacity to maintain circulation and pressure at all times.

Reverse rotary drilling is different in that the direction of flow of the drilling mud is reversed. This is done by using a larger pipe as the drilling pipe and instead of pumping the drilling fluid through it, it is used as a suction line supplying the circulating pump at the same time removing the loosened formation material. This loosened material and drilling fluid are pumped into a settling pit where the coarse material settles out. The drilling liquid is then either pumped or allowed to flow by gravity into the space between the drilling pipe and the drill hole. Under this method the drill hole must be kept full of water at all times in order to keep the suction lift within range of the pump. Ordinarily drilling can be done with any clean water and the use of very little if any drilling mud or aquajel is required, even in loose sands or gravels, so long as the drill hole is kept full of water. However, there are very few granular formations that do not contain some clay, therefore, the drilling water gradually becomes discolored and muddy. If a mud wall is built up by this method, it is much thinner and more easily removed than the wall usually built up by direct rotary methods.

It is apparent that in the reverse rotary method of drilling, larger formation particles can be and are removed, as the rotating bit is designed to move them toward the center of the drill rather than the outside. The size of the cuttings that can be removed are limited only by the diameter of the drilling pipe and the passages in the suction pump.

Inasmuch as the drill hole is kept full of water at all times, there is always a head on the water in the drill hole which reduces the possibility of caving to a minimum, also the downward movement of water outside of the drill pipe. It has also been found that the use of temporary casing is seldom necessary, though a short piece used as a blind at the surface will prevent excessive sloughing around the top of the drill hole.

The two methods are both fast and have other slight differences. These are mostly in the use of drilling mud and admixtures or in the operation of the pumps. Experienced operators are required in either case and adequate supplies of water must be at hand or provided. Due to the reverse rotary method using suction pumps to provide circulation rather than pressure pumps as used in the direct method, it must be remembered that the reverse rotary method is limited by atmospheric pressure to certain lifts depending on the elevation and efficiency of the pumps used.

In view of the fact that more accurate information can be obtained as to formation conditions and the danger of mudding up a hole is largely removed when the reverse rotary method is used, it is likely that this method of drilling rotary holes will become more general throughout the country in the next few years.

A young housewife went to buy a drinking trough for her cat. The clerk asked her if she would like one with the inscription "For the Cat."

"It really doesn't matter," she replied. "My husband never drinks water and the cat can't read."

Fred E. Butler drilling in the winter time in Wyoming. The picture is of a stock well. Mr. Butler says stock wells vary from 235 to 875 feet, some flow up to 20 g.p.m. but most of them have to be pumped.

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W. M. Bollenbach—
Business Manager
E. W. Bennison ..... Editor

Advisory Staff

K. M. Brown, Past President of A. A. W. W. D.

Jack J. Hinman, Jr., Col.—Corps of Engineers, U.S.A., (Rtd.)

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TOM'S COLUMN

Dear Fellows:

Looks like summer took the hard way to get here but the last few days have helped a little. Y'know, a fellow was tellin' of runnin' across a old almanack that was printed in 1913 and he says in there they made one of them long range weather predictions that took in the year of 1950. That was 37 years ago and it says that we could figger on there bein' practically no summer season in 1950. Whoever was doin' the star gazin' then, whether he was doin' it b'guess or b'gosh came pretty close to hittin' it right.

Anyway it was warm enough the other night fer a gang of us to gather round an outdoor fish fry down at a lake near here and after a few beers had been passed around the gab started, an' that led up to the usual bellyachin' about price cuttin'. Maybe no bunch of drillers ever got together that somebody didn't start in on that, an' I s'pose you noticed that whenever this touchy business of price cuttin' comes up it was always the other fellow who done the cuttin'. Well, most of us don't own up to it if we don't have to, but there's been times when all of us horsed around doin' some of it specially when things are tough. Maybe it was the beer that loosened me up although ma and the boys say I don't need no outside help when it comes to hoggin' the conversation, but I got to tellin' about a job I got way back in the early thirties an' I'd be a hog tied liar if I didn't admit that I got it by undercuttin' another driller. This driller used to operate in these parts an' he was tough competition. I never liked him personly, he was an overbearin' fellow but he knowed his business an' when he figgered a job he knowed what he was doin'. He made money an' he done good work. Well, things was awful tough and work was scarce. I needed money an' there wasn't many places to get it—well you know how it was back there in '31. This deal we was figgerin' on was a township job an' bids were called for. Me an' Swig McGrew went over there an' looked the place over. We hadn't ever done much work in there because this other driller, Wacker was his name, had handled pretty near everything around that area. The place had been havin' troubles over the year in gettin' a dependable water supply because it was one of them areas where the ground water was spotty, and Wacker knowed it a lot better than any of us did. He made 'em a proposition on bringin' in water from about three miles out, in fact he was able to show 'em by tests that there wasn't any other solution. Well, the commissioners was afraid to tackle it, didn't figger they could spend the kind of money it would cost. They wanted a guarantee, an' he told 'em under the conditions no self respectin' driller could give it to 'em.

Well, when they turned to me I got to shootin' off my big mouth and told 'em if they'd stake me to a few test holes I figgered we could get water in some central location that would be a big saving to 'em. This made Wacker pretty mad, an' when we got outside he

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told me he'd give me samples of tests he'd made that oughta prove I was stickin' my neck out. He said anybody who'd ever drilled around there knowed there was no known veins nor any broad sheets of ground water; his tests showed high rock at 30 feet in some places and scarcely any traces of sand an' gravel. Well, as I say, I didn't like the man an' I made out I didn't need no advice from him and he flared up an' sez by gad I needed it from **Somebody.** So Swig, who'd been standin' there chewin' his cut plug let go a stream of tobacco juice an' told him not to get his pants in an uproar. Wacker glared at Swig who wasn't much to look at bein' bony an' weazened an' mean eyed. Wacker was a hefty man an' it looked like he was goin' to pulverize Swig, but he just brushed his hands an' sez Tom, you better take that chromo an' drop him back in whatever swamp he crawled out of, an' he walked away. Well, Swig an' me got busy on some test holes, an' I never wanted to admit it but the situation was like Wacker had said. We did find some sand an' gravel down about 80 feet in one spot, an' I made out to the Commissioners that we could get water. Swig growled about it to me. He says I don't like that big lug no more than you do he says but you're losin' your marbles if you figger there's anything down there but some kind of a isolated pocket. Well I sez we gotta get some work don't we—and there's times when you gotta gamble some. Yes but says Swig these birds won't give you the work without a guarantee, an' you know dang well they're the kind that'll hold you to it, you can't soft soap them people. I told Swig he'd better stick to his part of the job an' I'd make the decisions so Swig says all right there's a lot easier an' more convenient ways of goin' broke than payin' off yokel commissioners, so he was goin' to born little gaffer walked away an' I get drunk. And by golly that stubborn little gaffer walked away an' never did see him agin fer a coupla months. Anyway I go ahead an' made a deal givin' 'em a guarantee of 100 gallons a minute with a bonus. When Swig didn't show I got hold of a helper I thought I

C. S. Raymer of Grand Rapids, Michigan, is an expert in shooting wells. Here he is using liquid nitroglycerine in a 14-inch rock well 350 feet deep. The capacity was increased to 450 g.p.m. from 60 g.p.m.

was gettin' cheap an' was mad at everybody includin' myself, an' it didn't help none to have Wacker watchin' that job from start to finish. Once he said to me Tom why don't you get 'em to agree to a time limit on that guarantee—say a year—but I told him to run along an' peddle his fish. Well sir, believe it or not, we hadn't got the rig set before we bumped into a straight five days of the dangdest weather you ever heard tell of an' the damage to the rig cost us another three days fer repairs. We run into everything the Lord ever put into the ground to drive drillers nuts from boulders to heavy beds of clay. I could have choked Swig McGrew when all the troubles began an' I learned something about tryin' to get things done with cheap, indifferent help. We snapped a cable fer no reason other than wrong adjustments, poor coupling stripped the threads an' lost me two lengths of pipe, an' one string of tools is still down in that blasted hole. I was fit to be tied—knowin' durn well that even if I hit water I was never gonna come out on the job. Well sir, after all these harrowing trials an' tribulations we finally got her pumpin'—an' fer the time it looked like I made the grade. I had my fingers crossed when I got out of there, an' I hoped I'd meet up with Wacker some day an' give him the horse laugh. As fer Swig, I'd just about decided to fry him in oil.

Things went along then an' the depression got worse—then one black day in '32 I get the news. Yes sir I'm called on to make good on the guarantee—an' before I got through with that nightmare of a job there was a second mortgage on the old shack an' I done some sweatin' until we finally got released from any further responsibility by the commissioners. As it turned out it was a isolated water pocket just like that ugly Swig said. That township is today bein' supplied from some three miles out an' I don't need to tell you that Wacker done the job. They never got around to recommendin' me as a good driller. Well, maybe that didn't cure me altogether, but I sure been leery about guarantees ever since. I gotta know fer sure that the water is there before they can get the John Henry on the dotted line. Wacker died a few years ago. As I say I never liked the man, but I'll hand it to him—even when times was tough an' he needed work he had the guts to tell his customers it would cost 'em less in the long run to get the job done right.

Well, after a few more beers we got to singin' an' I know you wouldn't want to be listenin' to that, so good luck to you all.

Yours truly,

TOM.

——o——

A haughty senior co-ed sniffed disdainfully when a small freshman cut in at the dance.

"Why did you cut in so abruptly?" she demanded.

"Well," he replied, "I am working my way through college and your partner waved a $5 bill at me." —Frivol.

"Yeah," said the sophomore, "When I first came here I was pretty conceited, but they knocked that out of me and now I'm one of the best fellows in college."

—Banter.

SURFACE and GROUND WATER CONDITIONS

During March the spring break-up started in the North-Central states. Storms in late March increased the flow and moderate floods resulted in eastern North Dakota, southern Minnesota and Michigan. Prospects are that spring runoff will be well above normal throughout the region for a good snow pack remains in most areas. Ground water levels are generally favorable, and if snow melt is gradual, substantial accretions to ground water storage may be expected.

The New York City water supply situation improved substantially and moderate floods occurred in upstate New York. Ground water supplies in northern New England have improved and are now near normal. Ground water levels in the Missouri River basin continued to show normal fluctuations, while water levels in shallow observation wells in Michigan and Indiana continued high. In contrast Wisconsin wells were at exceptionally low levels, particularly in Vernon and Monroe counties. Near Lansing, Michigan, ground water levels declined in the area of heavy pumping, but water levels were generally higher in the shallow observation wells in the glacial drift in the north-central part of the peninsula. In Indiana ground water levels showed no consistent trend during the month. They remained at or near the highest stages on record, following heavy precipitation in January and February.

In the southern Great Plains region the drought has become more serious, although stream flow continued above normal in the northern part of the region, runoff was deficient during March in Oklahoma and below normal in most of Texas. Ground water levels in shallow wells in Oklahoma declined during March and in the Lincoln, Nebraska, well field ground water storage has dropped rather sharply from the last two years, but is just above average for the past decade.

In northern New England states ground water levels throughout Massachusetts, New Hampshire, Vermont, and Maine rose appreciably during March and ground water storage which was far below average during the drought last autumn, can now be considered to be near normal for the season, except in Maine and part of New Hampshire.

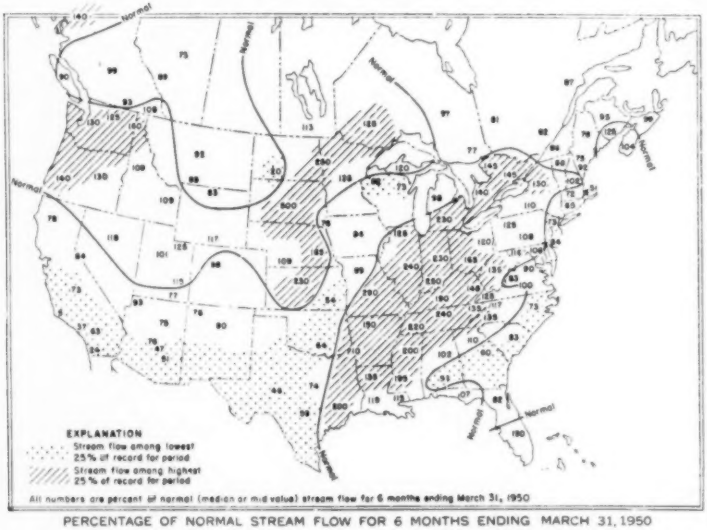
For the year ending March, 1950, the water levels in 250 wells in Nevada show changes from rises of 6 inches to 1 foot in the northern part of the state to declines of 1½ to 2 feet in the southern part of the state.

Ground water supplies in general are favorable although water levels may be expected to decline in certain areas of heavy pumping, particularly if summer precipitation should be deficient.

In April, 1950, major floods occurred in the North-Central states, Manitoba, and Ontario. The Red River of the North at the international boundary was reported to have reached the highest stage since 1826. Peak discharge of the Missouri River at Sioux City, Iowa, was greater than in 1943.

Ground water in the north and western part of Nebraska was in good supply. Reserves in the Box Butte County, where about 135 irrigation wells were in use last year, are favorable. The ground water reserves in the sand hills of Nebraska are excellent and should insure a good supply of water in the Loup, Niobrara, and Elkhorn River basins during the coming summer. In other parts of Nebraska, the normal spring rises of ground water levels has been retarded on account of insufficient precipitation. Water levels in the upper part of the Republican River basin are somewhat lower than a year ago but in the lower part of the basin they are about the same.

Ground water levels in southeastern Florida and in Oklahoma were generally lower than a year ago. In western North Carolina ground water levels have been constant since July, 1949; the normal seasonal fluctuation did not occur. Levels were below normal in southeastern Massachusetts, Connecticut, Long Island, and western New York.


Normal
EXPLANATION
Stream flow among lowest 25% of record for period
Stream flow among highest 25% of record for period
All numbers are percent of normal (median or mid value) stream flow for 6 months ending March 31, 1950

PERCENTAGE OF NORMAL STREAM FLOW FOR 6 MONTHS ENDING MARCH 31, 1950

We need pictures of your rigs in operation for use in future issues of this Journal.

Send either sharp glossy prints or clear negatives. We will return them if you want them back. Please send them in today. Thanks.

EDWARD E. JOHNSON, Inc.
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PROTECTION OF GROUND WATER SUPPLIES

EDITOR'S NOTE:

For a number of years we have been watching a development in the field of ground water that we feel should be of vital concern and interest to well drillers, engineers, and others engaged in the development, use and conservation of ground water.

We refer to a general awakening of the part of well users and public officials as to the importance and necessity of dependable sanitary ground water supplies. This has led to a number of regulatory and supervisory laws being passed having to do with licensing of well drillers, the adoption of well drilling codes, the construction of sanitary wells and the conservation of ground water.

In order that our readers may keep abreast of these developments, we intend to publish a number of these measures, some of which are now on the statutes and others that have been proposed. We feel that drillers should know about these things and be prepared to present their side of the case whenever such measures are up for consideration in their respective states.

All articles pertaining to these subjects will appear under the heading used for this article, so as to be sure our readers know what is going on.

WE WISH IT DEFINITELY UNDERSTOOD THAT IN REPORTING THE FACTS WE ARE NOT PASSING JUDGMENT ON THE MERITS OR NECESSITY OF ANY LEGISLATION NOW IN EFFECT OR THAT MAY BE PROPOSED LATER.

This is a horse power drilling rig used in Nebraska by Porter Worth. The picture was taken in 1907 during the drilling of a 2-inch tubular well 453 feet deep. The well is still in use. There are not many, if any, rigs of this type used today.

NORTH DAKOTA CONSERVES WATER

As far back as 1921 the State of North Dakota began to conserve water under the direction of Howard E. Simpson, then Water Geologist. Few states are as fortunate as North Dakota in having a vast bed of water under artesian head underlying most of the state. For years the cattle ranches and farms had the benefit of flowing wells and had become so used to strong wells under high pressure that they let their wells flow continuously which finally reduced the pressure and flow to the point where conservation measures were necessary.

A complete census of 6,000 artesian wells was made in 1921, the results of which were carefully studied by the State Water Geologist and over two hundred water samples were examined by the U. S. Geological Survey. The total flow from artesian wells in the southern tier of counties was about 1,450,000 gallons per day in 1923; by 1938 the flow had dropped to about 750,000 gallons per day, part of the reduction being due to shutting down of wells by the conservation program. In the period 1923 to 1928 practically all of the artesian wells in the state were visited by members of the State Geological Survey and the owners advised as to the conservation required by law and how changes could be made that conserve the flow of each well without detriment. Many wells were rechecked in the next ten years and the waste further reduced.

The policy of conservation was not confined to the artesian area alone, as the state is divided into four separate areas as far as ground water is concerned and the problems of each are fundamentally different. Furthermore, many of the wells in the state were in the surface formations above the deep artesian bed. These wells as a whole did not have the sources of supply that the deeper beds had and consequently were not as large in capacity. Many municipalities and industries depended on only one shallow well and as ground water use increased additional supplies were necessary.

This resulted in a program of ground water investigation with the State and the U. S. Geological Survey co-operating, which is still being carried on today with more requests for this service than ever before. Many cities and towns have taken advantage of this service to their benefit. The present State Geologist, Dr. Wilson M. Laird, has directed this work with great credit to himself, the North Dakota Geological Survey, the U. S. Geological Survey, and the people of North Dakota. Many towns now enjoy a satisfactory ground water supply that would not have been possible otherwise.

A large part of these results are due to close co-operation between the State Geologist and the North Dakota Well Drillers Association. Inasmuch as the development of ground water supplies in North Dakota requires skill, the well drillers through their association, the State Department of Health, and the State Geologist submitted a bill to the legislature in 1947 which had for its purpose the licensing of well drillers and the supervision and inspection of well drilling. This bill failed of passage due to a lack of preparation and with some changes will be submitted to the legislature again. There is no question of the benefits to be derived from such a law. Many states now have similar legislation; however, such legislation must be written so as to protect the interest and welfare of the public and not any special group. Some states have had such legislation proposed where there was no need for it, especially from the standpoint of conservation. Practically all state boards of health now have authority and power to control wells from the standpoint of sanitation, and it has been demonstrated that all such legislation must have the best interest of the people at heart and then, if passed, be enforced.

North Dakota as a state, however, is to be congratulated as the various state agencies and the well drillers have worked closely for years all to the end that the state's ground water supplies are properly developed, used, and conserved.

ASSOCIATION NEWS

This section is devoted to the exclusive use of water well drillers' associations, both state and local. Notices, announcements, changes of officers and other items should be sent to The Editor, Johnson National Drillers' Journal, 2304 Long Ave., St. Paul, Minnesota.

OKLAHOMA MEETING

The Board of Directors held a meeting March 27 at the State Department of Health, Oklahoma City, and decided to hold the spring meeting at the Extension Study Center of the University of Oklahoma on May 12.

A number of local speakers, including Dr. Stuart L. Schoff, District Geologist, U. S. Geological Survey, Leon V. Davis, Geologist, Oklahoma Geological Survey, and Mr. R. D. Sawyer, Vice-President of the association, spoke to the group at the morning session. Mr. L. J. Clarke of the State Department of Health and Mr. H. O. Halden of Calgon, Inc., at the afternoon session.

Friday and Saturday, November 23 and 24, were set for the dates of the 1950 convention. It will be held at the North Campus of the University at Norman. A round table discussion closed the meeting shortly after 5 p.m. in order that every one could be on his way home early in the day. Mr. L. J. Clarke, c o State Board of Health, Oklahoma City, is Secretary of the Association.

MISSOURI MEETING

At the recent meeting of the Missouri Association held at Rolla in April, the following officers were elected to serve in 1950: W. F. Steffins, President, Alma; B. H. Dake, Vice-President, Mountain Grove; Paul Clark, Secretary, Fenton; Roy Wallace, Treasurer, Rolla; Dale L. Fuller, Service Secretary. The following directors were also elected to serve: Ward Shelton, Ozark; Frank Weldon, Cape Girardeau, C. S. Wise, Jr., Kirkwood.

MICHIGAN MEETING

Michigan is planning their 22nd annual convention which will be held at the Armory Building in Lansing, June 20 and 21. The annual banquet and entertainment will be held at the Masonic Temple at 7 p.m. on the 21st.

The local units held their meetings throughout the state as follows: No. 1 at Pontiac; No. 2 at Kalamazoo; No. 3 at Monroe; No. 4 at Flint; No. 5 at Bay City; No. 6 at Sandusky. Locals No. 7 at Jackson, No. 8 at Lansing, and No. 9 at Grand Rapids planned to hold their meetings the later part of the month. Leo Riegler, Muskegon, is President of the association. Harold Armstrong of Battle Creek is convention chairman.

WISCONSIN MEETING

The 1950 meeting of this association was held as planned at Green Bay, May 19 and 20. During the meeting the following speakers appeared: Professor E. F. Bean on the subject, "Rainfall and Water Supply in Wisconsin," Mr. Joseph Egerer, drilling contractor from Milwaukee, on "Fishing Tool Problems and Questions," Professor F. T. Thwaites of the University of Wisconsin on "Drill Samples and Drilling Rates as a Guide to Shot Points." The new state supervisor of well drilling was present and introduced to the group.

Steinhoff & Sons, Florence, Kansas, manufacture drilling rigs as shown in the photograph. These rigs are known as Red Devil Water Well Drills.

Occasionally a well driller goes to town just as J. C. Funkhouser, a New Jersey driller, did in drilling this well on a busy street corner. The installation was refrigeration and air conditioning the market and apartments shown in the picture.

Some twenty exhibitors reserved space which was held at the Northland Hotel. The ladies' auxiliary met at a noonday luncheon followed by a bus tour of Green Bay and the bayshore. The meeting closed with a banquet and entertainment at the hotel. Mr. R. H. Nienow, Executive Secretary, Merrill, was in charge of arrangements.

MONTANA MEETING

The Montana Association held its fifth annual meeting at the Civic Center in Lewistown, April 3 and 4 with sixty members in attendance.

Speakers were Frank A. Swenson of the U. S. Geological Survey at Billings, Dean W. M. Cobleigh of Montana State College at Bozeman, Calvin D. Hembree of Casper, Wyoming, Albert J. Gates, Director of the Montana Chamber of Commerce, and others.

W. W. Gail, a newspaperman from Billings, was the after-dinner speaker and left some timely thoughts with those attending. The meeting decided to hold their annual meeting at Lewistown again next year.

The entire list of officers was re-elected to serve another year. Mr. Robert I. McCutcheon of Havre is President and Loren E. Anderson of Billings is Secretary-Treasurer.

KANSAS MEETING

Fifty drillers and guests attended the Southwest Kansas regional picnic held at Garden City, Sunday, April 30. Mr. and Mrs. Waddell made the local arrangements. The next regional meeting will be the Northeast at Lawrence on July 8.

In the meantime plans are being made for the annual meeting at Great Bend on October 13 and 14. A. R. Leonard, Service Secretary, Lindley Hall, University of Kansas, Lawrence, can give you the details.

VIRGINIA MEETING

This association, while comparatively young, was successful in its efforts to get relief from the rigid inspection required of well drilling equipment mounted on trucks. Lights are now not required on drilling equipment, provided it is not on the highways between sunset and sunup. The officers and directors are also working on an educational program in conjunction with some of the colleges in Virginia.

The next meeting of this association will be held at the Patrick Henry Hotel in Roanoke, September 29 and 30, 1950. Drillers and others interested please note this is a change in dates as originally planned.

K. D. Thompson of Wibaux, Montana, drills in all kinds of weather and formations most of them bad. The picture is one of his rigs working in the snow on a nice winter day. Mr. Thompson is active in the affairs of the Montana Drillers Association.

The Heater Well Company of Raleigh, North Carolina, operates one of the largest fleets of well drilling rigs and service trucks in the country. The picture shows 22 service trucks alone with drivers. In addition to the 19 drilling rigs, each of which has a service truck, there is a heavy Mack truck tractor for hauling pipe. Mr. Heater is a past President of the North Carolina Drillers Association.

WASHINGTON STATE MEETING

The first regional meeting of this association was held at Olympia, March 18, with twenty-four drillers and several supply men and others interested in the drilling of water wells present. Mrs. Helen Davis is acting as Secretary for the news items going into a bulletin. The next regional meeting will be in Wenatchee, July 15. Mr. O. E. Erdman of Elma is Secretary-Treasurer of the Association.

OREGON MEETING

According to trade reports a group of drillers in Oregon have formed an association with T. J. Burkhart, President; Ed Jensen, Vice-President; and Ken Brooke, Secretary-Treasurer. The next meeting will be held July 3, 1950, in Portland.

PENNSYLVANIA MEETING

Plans are being made for the organization of a well drillers association in Pennsylvania. Preliminary meetings attended by a number of drillers and representatives of the Pennsylvania Geological Survey and the U. S. Geological Survey have been held at Harrisburg, Pennsylvania.

OHIO MEETING

A meeting of this association was held in Columbus, April 15, with representatives of the Permutit Company, the Carter Products Company of Cleveland, and the Miami Boiler and Machine Company appearing on the program. Mr. E. D. Allen, Steubenville, is Executive Secretary-Treasurer.

FLORIDA MEETING

The 10th annual meeting of this association was held at the Lamar Hotel in Orlando, March 31 and April 1. About 50 drillers were present with a number of interested manufacturers and state officials.

During the session Mr. Nevin D. Hoy, District Engineer, U. S. Geological Survey, spoke on Water Wells in Florida. Dr. Herman Gunter, Director of the Florida Geological Problems Pertaining to Wells. David B. Lee, Chief Sanitary Engineer of the State Board of Health, spoke on Pollution Pertaining to Wells.

The meeting closed with a banquet at the El Patio Club and installation of officers. Dr. A. C. Lovejoy acted as Master of Ceremonies assisted by the Daniels Sisters, entertainers. Mr. J. P. Carrol of West Palm Beach was elected President for the 1950 term, L. E. Owens, Jacksonville, First Vice-President, Vaughan Dibble, Mt. Dora, Second Vice-President, R. M. Vicker, Miami, Secretary, and J. L. Knight, Vero Beach, Treasurer.

NEVADA MEETING

Mr. Hugh A. Shamberger, Assistant State Engineer, recently met with a group of drillers which resulted in the formation of the Nevada Water Well Contractors and Drillers Association. Mr. S. R. McKinney of Las Vegas was elected President.

Professor—"Name a liquid that won't freeze."

Freshman—"Hot water."

—The Covered Wagon.

Missouri Water Well Drillers' annual banquet at Hotel Edwin Long, Rolla, Missouri, in April, 1950.

ADVERTISEMENTS

We will insert advertisements for drilling equipment wanted or for sale, help or work wanted, etc., for our readers, free of charge. Advertisements must be brief, and we cannot assume responsibility for them, but will be glad to put parties in touch with each other by this means and suggest that they investigate any offers or inquiries carefully for themselves.

DRILLING MACHINE AND TOOLS for sale or trade for car or pickup. Write: Everett Ramey, R.R. No. 3, Weatherford, Okla.

HELP WANTED: Reliable cable tool driller to operate new 42 Cyclone; mostly 5⅝" diameter; farm and suburban wells in rock or gravel; real opportunity. Write: Curtis C. Conway, 213 N. Robert Blvd., Dayton 2, Ohio.

FOR SALE: Jerkline well drilling rig, all steel, for sale; U belt drive, water cooled cathead, model B Ford motor, mounted on 1935 International truck. For sale cheap. Write: William Mantyla, Stillwater, Minn.

WANTED: Used drill tools for wells from 6 to 30 inch; such as bits, stems, sockets, bailers, etc. Interested in one piece or carload, if price is right. Send full particulars as to pin size, weight, price, etc. Write: Libby & Freeman, P. O. Box 2927, Orlando, Florida.

FOR SALE: One Bucyrus-Erie 21-W well drill mounted on D-35 International Truck, 1937 Model; drilling tools for three and four-inch wells; derrick is 31½ feet with rubber shock; machine and truck in first-class condition; good rubber on truck; 500 feet of practically new ⅝" drill cable; sand line is less in length but good condition; drilling tools consist of 2½" x 12' stem; 1 set jars, 1 stiff neck socket; two 4" bits and two 3" bits; 2 cast steel tool wrenches; 1 tool tightener, 1 drive clamp; 2 dart valve bailers. Write: W. G. Law, Troy, Alabama.

FOR SALE: Loomis No. 2 clipper machine with 6-cylinder engine on engine mounted on hard rubber; in good shape; Bucyrus-Erie crown sheve and shock absorber; tool guide and belt; about 300 feet ¾" cable and 300 feet ⅝" cable; tools, bar, jars, swivel socket, bits, tool wrenches, and chain tighteners; drive blocks; in good condition. Write: Lawrence Martin, 407 North Fifth Street, Oregon, Illinois, Phone 127-K.

FOR SALE: Howell No. 60 well drill. Write: The Alton Cement Works, Alton, Iowa.

FOR SALE: No. 240 Speed Star used very little, mounted on 1937 International truck complete with all tools, bits, etc. Must sell to settle estate. $2,500.00. This machine was new in 1947. Write: Bill Hall, R.D. 2, Andover, Ohio.

FOR SALE: G.M.C. 1½-ton Int., 1½-ton Mack, 3 ton. Has 3 drum winch, all steel, for drilling wells or pulling pipe, ring slips, jacks, elevator 2' to 12' blocks, hooks, cables, chain tongs, light and heavy, air com. 2 cylinder blowers, f r-age, etc. One No. 28 Star, engines old, sand line sold, 2,500 ft. ⅞" w. cable, with tools from 2" to 12", bit, jars, D-clamps, heads, track and jack, rope clamps, crane, hoist, S. wrench, bailers, etc., $3,000.00 cash; 6" or 8" drill stems. Will carry one-half interest with the right fellow, must be able to weld electric and gas, sober, and under 50 years old, and know the drilling game. Also will rent a 150-foot by 50-foot steel and cement building for storage and shop. Address: Lock Box No. 64, Rock Glen, New York.

FOR SALE: One Ferguson well drill all-steel frame with wood mast 28', mounted on 4-wheel trailer with hard rubber tires; powered with 6 H.P. Fairbanks-Morse engine. Will sell very cheap. For more details, write: Shepard Bros., Well Contractors, 4047 Eighth Street, Des Moines, Iowa.

FOR SALE: One No. 5½ Keystone drilling machine, newly rebuilt, mounted on a 4-ton truck, with 6¼ and 8¼ bits, 4¾" by 23 ft. stem, jars, and rope sockets for manila and wire lines, sand bucket for 8" hole and dart valve bailer. No. 2 track and jack, 4" tool wrenches, blower, ground tank and steel wagon or truck tank. Write: Sewell Well Company, 3970 Folsom Avenue, St. Louis 10, Mo.

FOR SALE: Failing 1500' and 1000' capacity drills, complete, drill rod, bits, tools, etc. Working in South Dakota. Write: Fred E. Butler, Box 1832, Casper, Wyoming.

WANTED: Experienced water well driller. Work in the Detroit area. References. Write: Box No. 196, Franklin, Michigan.

(Continued on Page 15)

These are the three rotary drilling rigs offered for sale either as a group or separately by the American Water Company, Bay City, Texas. See details in Ads.

(Continued from Page 14)

FOR SALE: Drilling Rig; one No. 21A Bucyrus-Erie with Cathead; 2 years old, mounted on 1936 Dodge Truck. Truck is in good condition. Machine complete with cables but less tools. $2,500.00. One No. 35 Armstrong Band Wheel Type, semi-mounted. No. truck furnished. Price $1,500.00, which includes a new rope 7 Tools for 5", 6" and 8" work. Rig has been well maintained. Ray D. Lacy, 4919 London Road, Duluth, Minn.

WANTED: Experienced well driller for work in southern New England; good wages and steady work. In reply, please state age, experience, and references. Write: Gaines Drilling Company, Rockville, Conn.

WANTED: Steady job as driller; married with one child. Write: Lloyd Bjorklund, Holmes City, Minnesota.

WANTED TO BUY: All-steel drilling rig for 5-inch work with or without tools. Write: Joe Erhard, Box 275, Renville. Minnesota.

FOR SALE: Well Auger rig mounted on Dodge truck; truck motor drives auger; has augers and plenty of rods. Write: Joe Erhard, Box 275, Renville, Minn.

FOR SALE: No. 25 Armstrong trailer mounted on hard rubber, with Bucyrus rubber shock absorber in derrick; roller bearing jack shaft, for V-belt drive; no motor nor tools. Good machine for deep clean-out or 1200 ft. drilling. Cash $1000.00. f.o.b. Delafield, Wisconsin. Write Gray Well Drilling Company, P. O. Box 181, Delafield, Wisconsin.

BUSINESS OPPORTUNITY: Partnership or will sell outright, Bucyrus-Erie 21 W mounted on G.M.C. army truck; all tools for drilling 2" to 6" wells; shop equipment including oil furnace, blacksmith forge, actylene and portable Lincoln electric welder, pipe, pumps, and supplies, shop 20' x 40', two homes. If interested, write: Thomas Beadle, R. R. 2, Cheboygan, Michigan.

FOR SALE: One Sparta band wheel type with band wheel clutch 36-foot telescope mast; calf reel with ½" cable; 500 feet ⅝" cable; 300 feet ⅜" cable; mounted on '36 Federal 2-speed axle 5-speed transmission truck; can be had with semi-equipment; with or without tools. Write: Martin Mastrian, 502 - 4th Ave. East, Superior, Wisconsin.

FOR SALE: Well drilling machine for sale; cathead; two 4" pumps driven by Chevrolet power, mounted on 1936 L. W. B. Dodge truck, in good shape, tools, large tool chest and some supplies; selling on account of health and age. Write: Louis H. Schlacht, Box 367, Monticello, Minnesota.

FOR SALE: Ideco No. 10 complete with 500 ft. cable and sand line; a complete set of tools for 4" well, mounted on a Ford V-8 1941 truck; machine has been out one year. Priced to sell. Also have for one No. 3A Engineering Laboratory core drill with 200 ft. of 1¼" drill stem and tricone bits for 4" hole. This outfit is easily attached to any cable tool outfit; this has a 5½ H.P. B. & S. Engine to turn rotary table; this outfit can be installed or taken off of cable tool outfit in 10 minutes time. Selling on account of ill health. Write: C. E. Stevens, Findlay, Ill.

WATER LEVEL INDICATOR

The Fisher Research Laboratory, Inc., Palo Alto, California, has developed a small, compact, and easily portable water level indicator to determine accurately the depth to water in a well or drill hole. By means of this device, engineers, geologists, and well drillers can obtain accurate information regarding the water table under static, pumping, or seasonal conditions.

The cable, batteries, and operating components of the Model WL equipment are all included in one compact spool type unit, which operates on two 45-volt dry cell batteries. The circuit is such that when the instrument is turned on, a bright neon bulb will burn. The cable with its attached electrode assembly is then slowly lowered into the well. The moment the two electrodes of the electrode assembly touch the water surface, the neon bulb will go out. When the assembly is removed from the water, the light will go on. The unit is simple and positive in operation.

As an added feature, the spool is designed to be used as a convenient reel for taking in and letting out the cable. A small chrome plug is removed from the base of the unit and a screw driver inserted in the exposed hole. By using the bakelite knob on the top of the instrument, it is possible to turn the spool and reel the cable either in or out. The spool on the WL model is equipped with 250 feet of cable, however, any additional amount required can be provided. Prices are based on the length of cable wanted. Fisher Research Laboratory, Inc., 1961 University Avenue, Palo Alto, California, will furnish additional information on request.

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(Ads Contd.)

JOB WANTED: By experienced driller in rock, sand, and gravel, screen installations, and pump repairs. Write: Box J. B. c/o Edward E. Johnson, Inc., 2304 Long Avenue, St. Paul 4, Minn.

WANTED: Number 55 Speed Star, used but in good condition and reasonably priced. Write: Jacob Kons, Route 4, Appleton, Wisconsin.

WANTED TO BUY: A good used 22-W Bucyrus Erie drilling rig, without tools and truck. Write: Ed Kriegel, Antigo, Wisconsin.

JOB WANTED: Experienced driller of ten years: 32 years old; have had own business 5 years; am now in territory with much competition; would like work in new territory; will go anywhere; am also interested in foreign drilling. Write: Lyle Mix, Potterville, Michigan.

WANTED: Used drilling machine; would prefer a 55 Star, a late model 240 Star or other equivalent make; with or without tools; also interested in used cable tools for holes ranging from 10-20 inch. State price and condition. Write: J. Kriska, Seffner, Florida.

FOR SALE: Three rotary drilling rigs with 45-foot derricks; one mounted on Diamond T-truck; another on K-7 International truck; and one is a skid rig; all three of these rigs will be sold singly or as a group at bargain prices. Write: American Water Company, P. O. Box 626, Bay City, Texas.

FOR SALE: All tools and equipment necessary for a rig to drill 10, 8, 6, and 5-inch holes; including light plant, water tank; 575 ft. 6⅝" I.D. 17 lb. casing; 45 feet 8" 28 lb. casing; two good 18 H.P. power units; complete for $2250.00. Write: Paul Pierson, Longton, Kansas, phone 174.

One Way Of Looking At It.....

In establishing the design, quality of materials and production of Johnson Well Screens, the questions which must be answered by our manufacturing department are:

Will they be more efficient?

Will they give more water?

Will they be stronger?

Will they last longer?

Will they do a better job at less cost for the man who buys them?

This is the Johnson point of view stated in a few words —a policy which has won for our products a wholehearted respect and confidence wherever screens are used.

"Built up to standard—not down to a price"

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